IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 04, Issue 05 (May. 2014), ||V3|| PP 13-21

A practical study for incident solar radiation intensity in Basrah province and air temperature

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Abstract: - The study was conducted in Basrah province, Iraq in 2004 to investigation of incident solar radiation intensity there. The results showed that the solar radiation intensity increased with the increase of daylight hours and reached to maximum value at mid-day then dropped until it reached less value at four o'clock in the evening for all the different days of the year months. A maximum air temperature reached to 20, 24, 35, 38, 38, 42, 44, 46, 46, 40, 35, and 20 ^{o}C from Jan. to Dec. respectively.

Keywords: *- solar radiation, air temperature, day hours*

I. INTRODUCTION

A know ledge of the local solar-radiation is essential for the proper design of building energy systems, solar energy systems and a good evaluation of thermal environment within buildings [1, 2, 3, 4, 5 and 6]. In the design and study of solar energy, information on solar radiation and it is components at a give location is very essential. Solar radiation data are required by solar engineers, architects, agriculturist sand hydrologists for many applications such as solar heating, cooking, drying and interior illumination of buildings [7]**.** Predicted to be the clean energy of tomorrow, solar energy has been in the forefront of energy development in many developed countries and a potential source of energy to developing countries like Malaysia[8].

Al-Hilphy [9] stated that the intensity of solar radiation increased significantly ($p<0.05$) as daylight hours increasing reaching a maximum value of 740 `W/m^2 at midday and then decreased after that. Over the years, numerous models for evaluating the hourly solar radiation appeared in the literature. The first attempt to analyze the hourly global radiation data was made by Whiller [10] and Hottel and Whiller [11] on the basis of solar radiation data of various locations in U.S.A., to obtain the variation of hourly to daily radiation ratio against sunset hour angle [12]. A know ledge of the local solar-radiation is essential for the proper design of building energy systems, solar energy systems and a good evaluation of thermal environment within buildings [13-18].Madhi [19] Found in the city of Basrah, the measured and calculated solar radiation intensity that incident on the inclined surface 20 deg. angle in September 1984 was increased with the increase in daylight hours and up to the maximum value at midday and then down to the end of the day, when daylight hours 9, 10, 12, 14 and 16, the values of the measured solar radiation intensity were 965, 1070, 945, and 500 W/m^2 also, the calculated were 770, 910, 990, 850 and 450 W/m^2 respectively.The aims of present study to investigation the air temperature and incident practical solar radiation intensity on the Basrah province and study their changes during different times.

II. MATERIALS AND METHODS

Solar radiation intensity was measured by pyranometer device which manufactured by Kipp and Zonen Company, Netherlands, type CM11.A factorial experiment with completely randomized design was used. LSD test at 0.05 significantly level was used to compare among treatments means using SPSS software [20]. The monthly average of solar radiation intensity was taken to three different days of each month.Air temperature was measured using thermometer which made of England.

III. RESULTS AND DISCUSSION

Solar radiation

Observed from figures 1 to 12 which show the practical solar radiation intensity during daylight hours for different days with clear sky in the all months of the year 2004, that the solar radiation intensity increased with the increase of daylight hours and reached a maximum value at mid-day then dropped until it reached less value at four o'clock in the evening for all the different days of the year months. This is due to the Earth's rotation on it is axis and as a result change solar angles with daylight hours, which include zenith angle and altitude angle and azimuth angle and reaches the value of the last to zero at midday and to great value at sunrise and sunset as well as changing the angle at hour angle with the daylight hours. These results are agreed with [21,

22] Who confirmed that the intensity of solar radiation increases with increasing daylight hours and up to a maximum value at midday then reduced after that.The results showed that the practical solar radiation intensity at 12:00 in June less than 11 and 13 hours at the same month, this due to present little clouds in the sky at 12:00 only.

The highest intensity of solar radiation was 1024 W/m^2 at 12:00 in February while the less solar radiation intensity was 823.29 W/m^2 at 12:00 in October.

Air temperature

The results showed in the Figs. of 1 to 12 that the air temperature has increased with the increase in daylight hours and reached a maximum value at three o'clock in the afternoon in Jan., Mar., Jun., Aug., Sep. and Dec. and at 14:00 pm in Feb., Apr., Jul. and Nov. and at 13:00 pm in Oct. then dropped. For example, air temperatures reached to 10, 10, 11, 14, 17, 18, 19, 20, 15^{o}C during the day hours 8, 9, 10, 11, 12, 13, 14, 15, 16 respectively in Jan. On the other hand, A maximum air temperature reached to 20, 24, 35, 38, 38, 42, 44, 46, 46, 40, 35, and 20 ^{o}C from Jan. to Dec. respectively.

The reason for the increase in air temperature with increasing daylight hours is to increase the intensity of solar radiation falling on the ground. The presence of differences in the maximum value of the temperature of the atmosphere is due to the presence of dust, as well as some scattered clouds in the atmosphere, leading to influence the intensity of solar radiation which directly impact on the temperature. These results agreed with Al-Hilphy[23], Al-Hilphy[24], Al-Hilphy et al.[9] Al-Hilphy et al. [25], Al-Hilphy[26] and Al-Hilphy et al. [27] Who found that practical solar radiation intensity falling on horizontal surfaces and inclined surfaces with angle of 30 degrees has increased significantly ($P<0.05$) with increasing daylight hours and reached a maximum value at 12:00 noon then decreased thereafter to reach the lowest value at four o'clock pm.

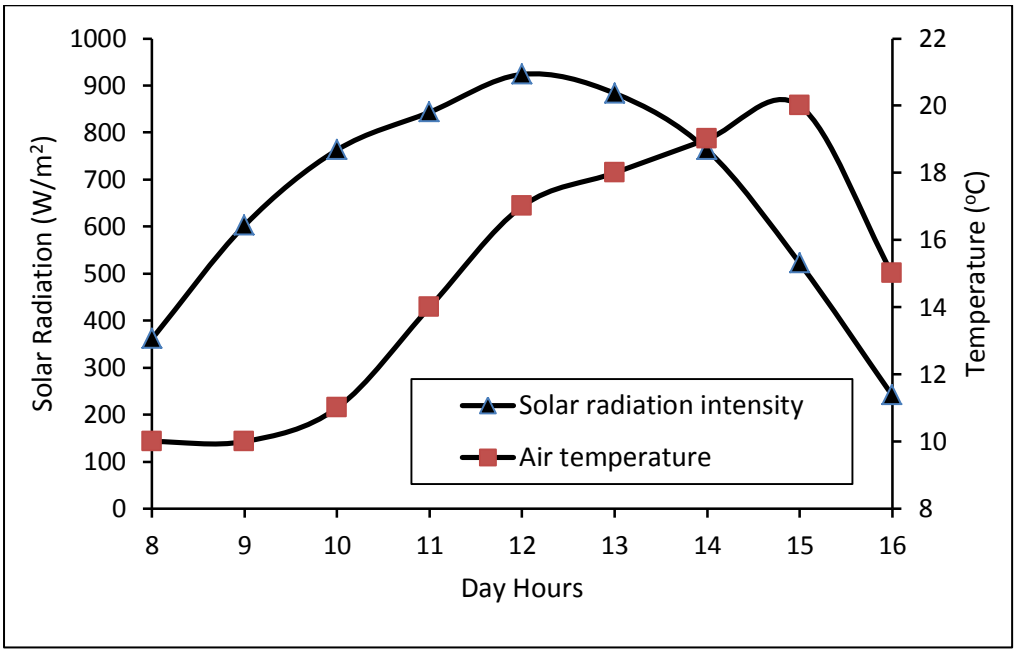

Fig.1. Incident solar radiation intensity on an inclined surface is making an angle 40^o with the horizontal in January.

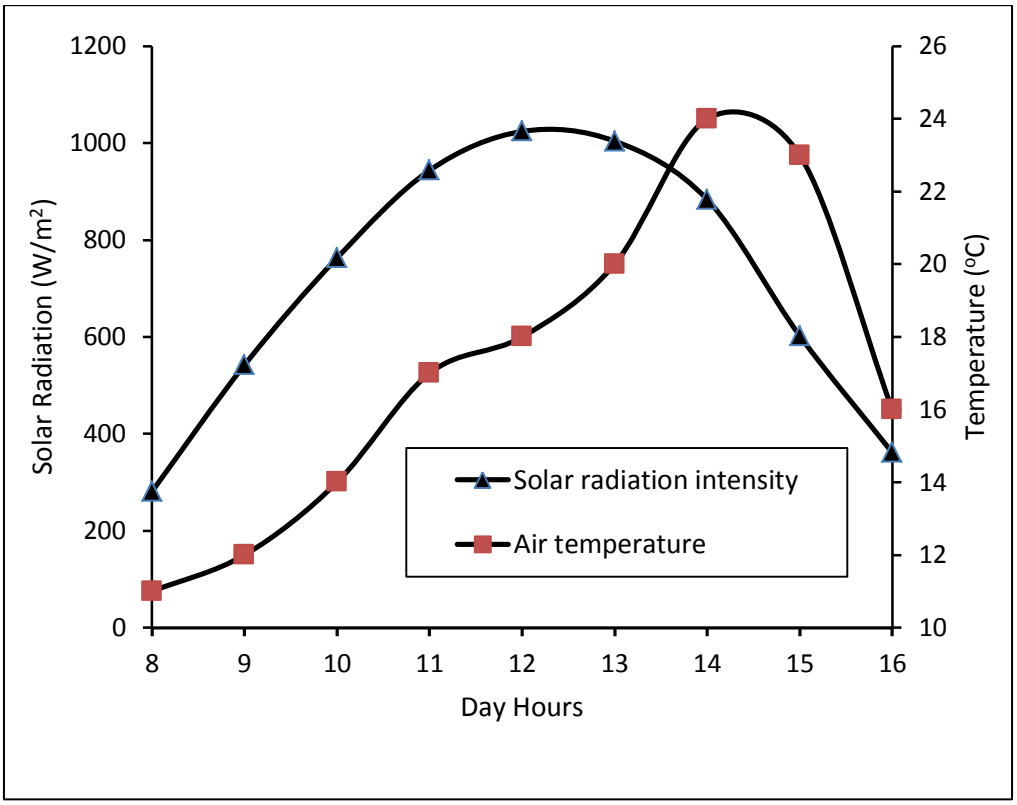

Fig.2. Incident solar radiation intensity on an inclined surface is making an angle 40° with the horizontal in February.

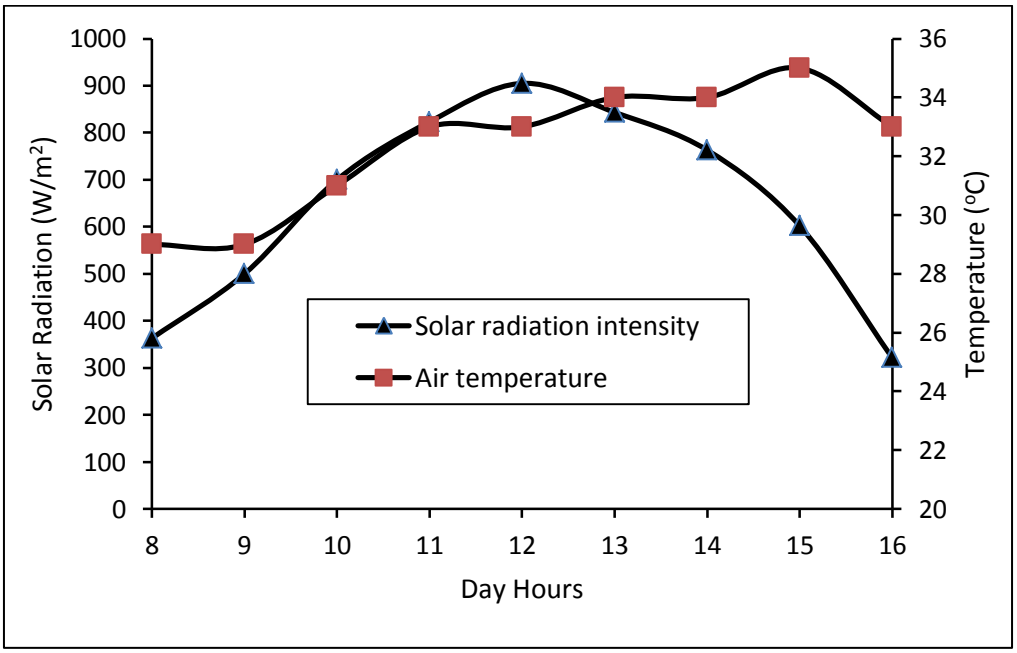

Fig.3. Incident solar radiation intensity on an inclined surface is making an angle 40° with the horizontal in March.

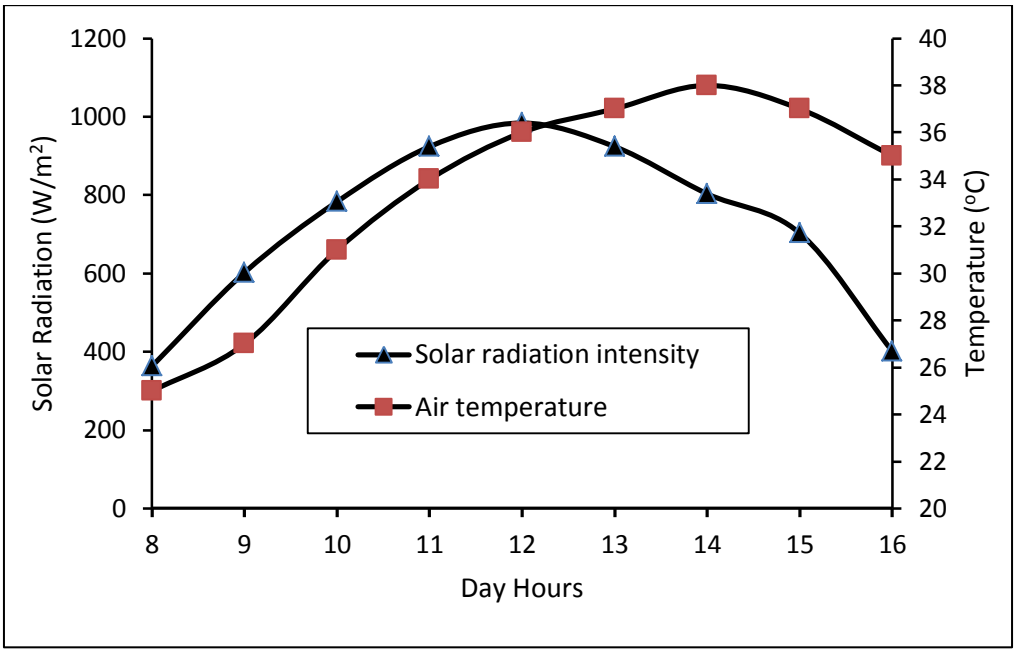

Fig.4. Incident solar radiation intensity on an inclined surface is making an angle 40° with the horizontal in April.

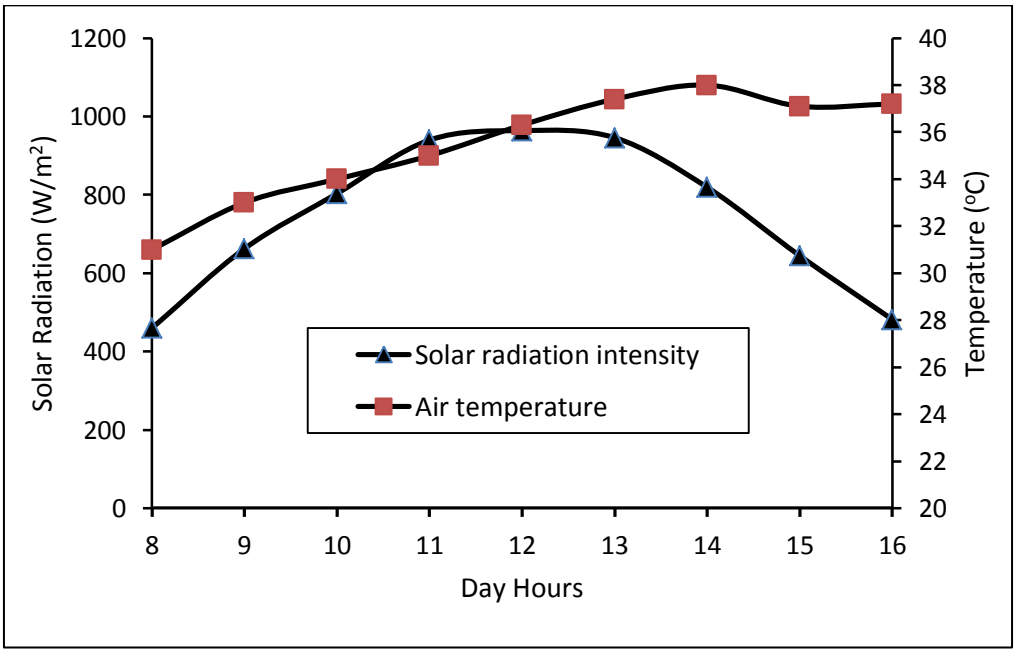

Fig.5. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in May.

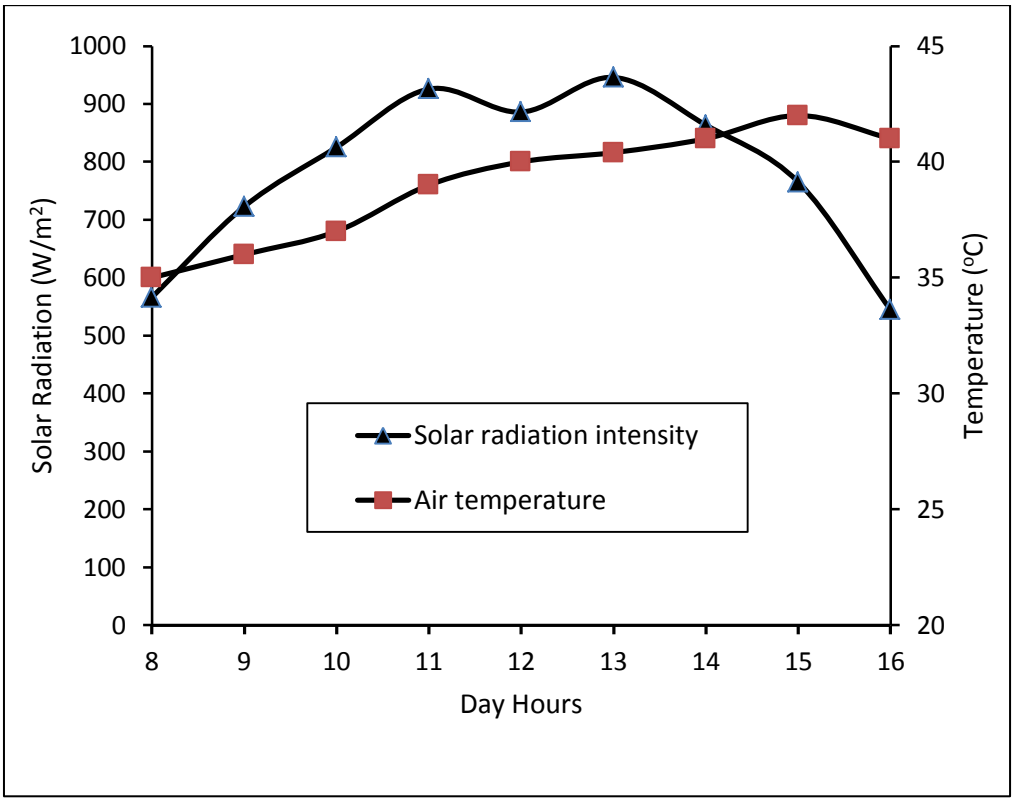

Fig.6. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in June.

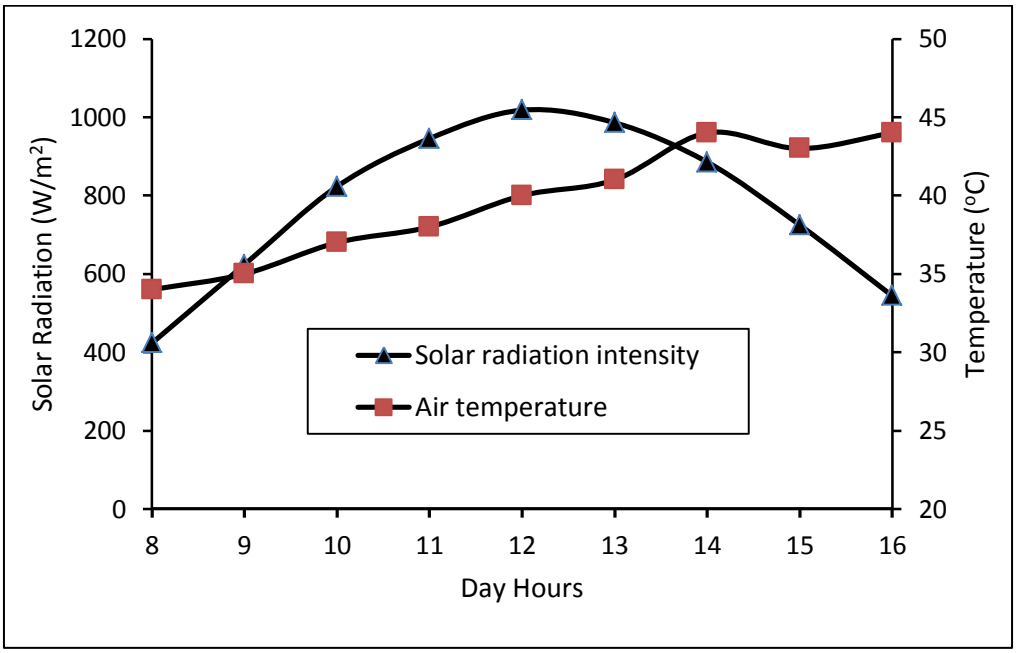

Fig.7. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in July.

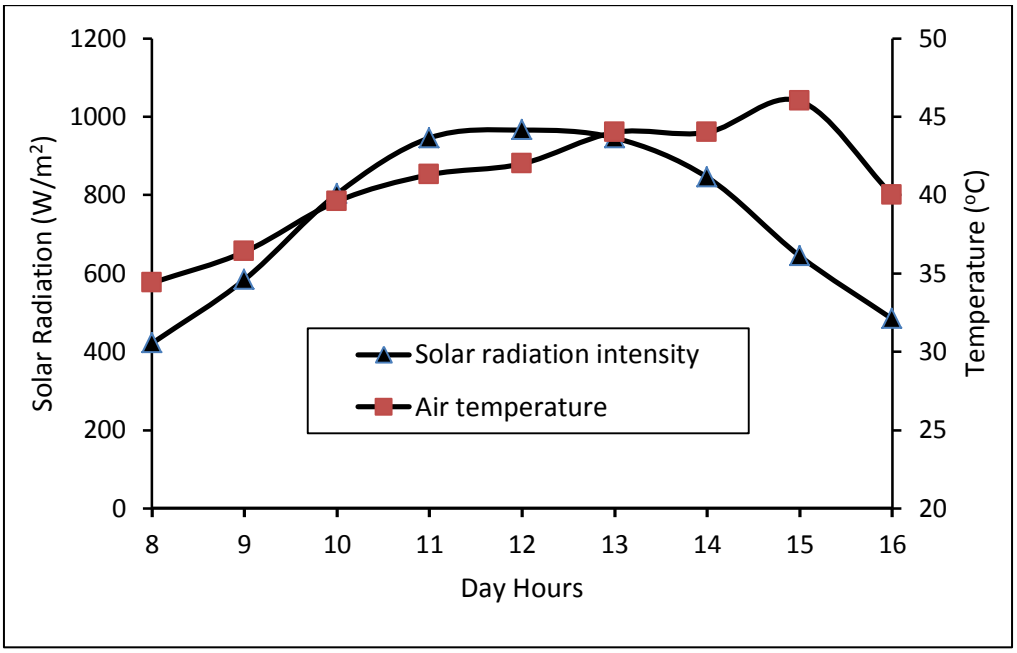

Fig.8. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in August.

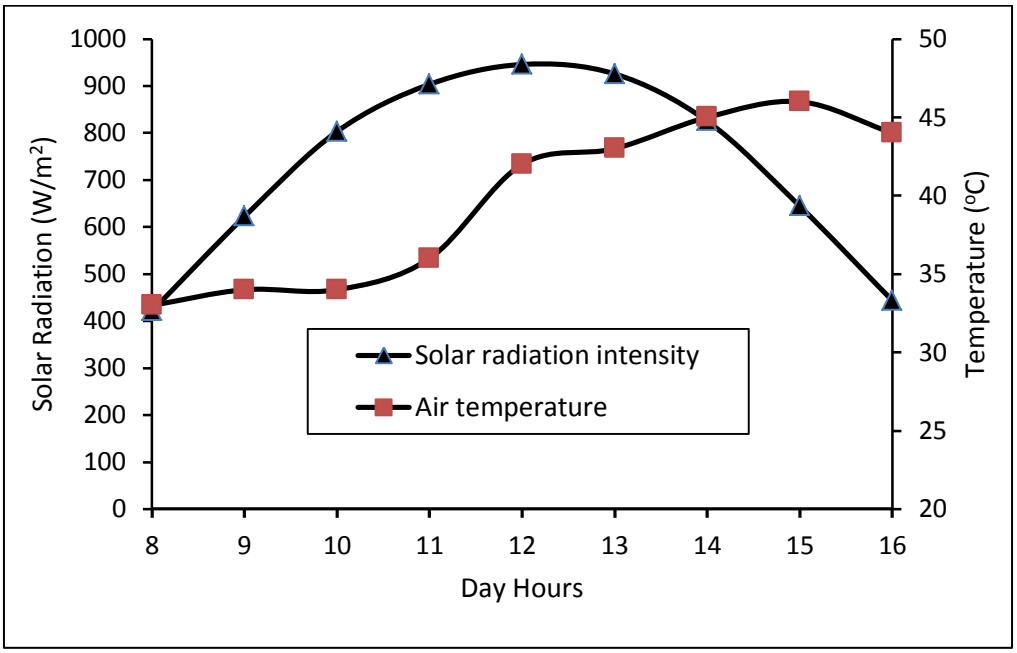

Fig.9. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in September.

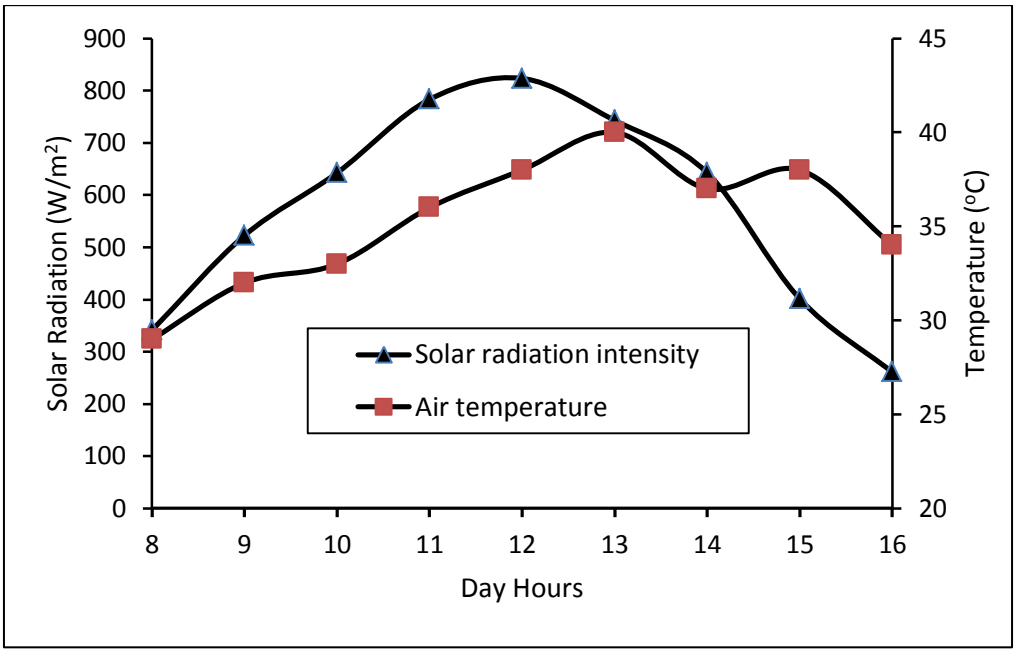

Fig.10. Incident solar radiation intensity on an inclined surface is making an angle 20° with the horizontal in October.

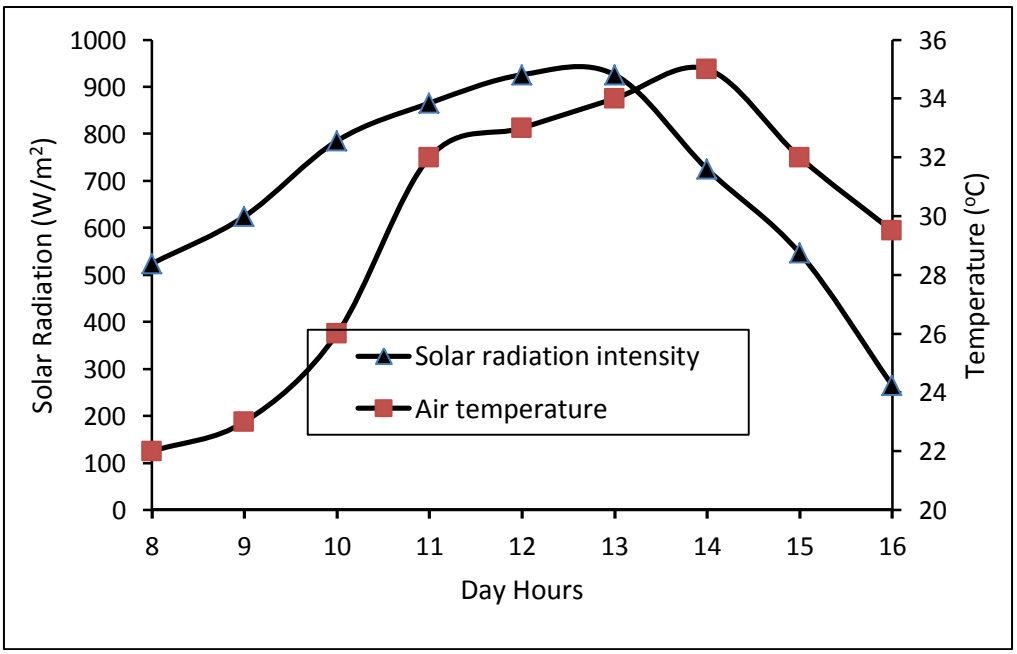

Fig.11. Incident solar radiation intensity on an inclined surface is making an angle 40° with the horizontal in November.

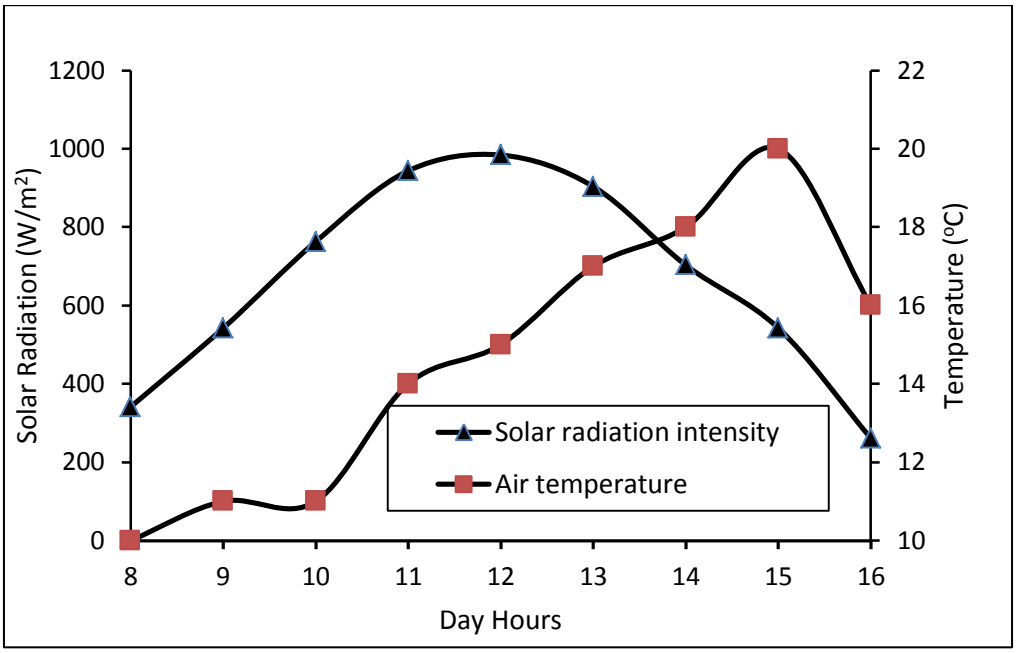

Fig.12. Incident solar radiation intensity on an inclined surface is making an angle 40° with the horizontal in December.

IV. CONCLUSION

Throughout the results of the study, solar radiation was increased with increasing day hours and reached to maximum value at mid day then reduced. Air temperature was increased with increase of day hours and reached to maximum value at three o'clock in the afternoon in Jan., Mar., Jun., Aug., Sep.and Dec. and at 14:00 pm in Feb., Apr., Jul. and Nov. and at 13:00 pm in Oct. then dropped.

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